REMARKS

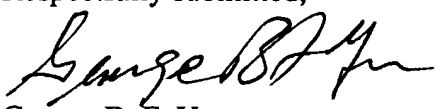
The specification has been replaced pursuant to M.P.E.P. §608.01(q). No new matter has been added. The Abstract has been replaced. Claims 11 - 15 have been appended.

CONCLUSION

Pending claims 1 - 15 are believed to be in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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APPENDIX B: SPECIFICATION AS FILED, WITH MARKINGS TO SHOW CHANGES MADE

Please amend the specification as originally filed as follows:

Backup Processing Method

CROSS-REFERENCES TO RELATED APPLICATIONS

NOT APPLICABLE

STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

NOT APPLICABLE

REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISK.

NOT APPLICABLE

BACKGROUND OF THE INVENTION

~~1. Field of the Invention~~

The present invention relates generally to a backup processing system ~~to back up the data of~~ for data processing systems executing on-line processing and batch processing, and more particularly to ~~a technology effectively applicable to~~ backup processing ~~systems~~ technology capable of preventing ~~the~~ backup processing ~~from being prolonged~~ delays when trouble occurs during a backup operation ~~processing~~.

~~2. Description of the Related Art~~

On-line processing and batch processing in data processing systems of banks, securities firms, etc., sometimes ~~come to an abnormal end~~ terminate abruptly due to bugs in the programs, trouble with storage devices, etc., leaving data in an inconsistent state. Moreover, ~~D~~data are sometimes erased by human errors made ~~by persons engaging in~~ during data processing. ~~Known in order to restore data processing systems in such trouble are s~~Several means are known for correcting ~~such~~ the inconsistencies in such

data, ~~and~~ restarting ~~such~~ the data processing ~~again~~ or redoing such data processing from scratch. ~~With one of the~~ One means~~;~~ restores a data processing system ~~is restored~~ by backing up data from time to time and restoring the data if trouble has occurred.

With the means for backing up and restoring data, data of a database system, for example, ~~a database system~~ are regularly backed up ~~regularly into~~ to a storage medium such as ~~a~~ magnetic tape. If trouble occurs in the database system, the data are restored from the magnetic tape to the database system storage device, ~~of the database system and t~~The backup system dates back to an appropriate point in time to reconstruct the data in the storage device of the database system. Thus the data of the database system are restored so that ~~the database~~ processing can ~~be started again~~recommence.

In the case of batch processing, the data ~~of~~in the system's storage device ~~of the system~~ are backed up ~~into a~~ on magnetic tape prior to batch processing. If batch processing comes to an ~~abnormal~~ irregular end, the data are restored from the magnetic tape to the storage device, and then batch processing is started again from scratch.

~~Disclosed in~~ JP-A-242437/2000 ~~is~~ discloses a storage-device system which makes a copy of data to be backed up in its storage device so that backup data can be made not from the data, but from the copy; therefore access to the data in the storage device is not ~~disturbed~~ disrupted even while the data are being backed up.

~~While~~ Sometimes, data are being backed up ~~into a~~ on magnetic tape, ~~by the means for backing up and restoring data~~ as described above, backup processing ~~sometimes~~ comes to an ~~abnormal~~ irregular end due to trouble with the magnetic ~~-~~tape drive or the magnetic tape. In this case, another magnetic ~~-~~tape drive and another magnetic tape ~~have to~~ must be ~~prepared and~~ readied, the data-backup processing ~~has to~~ must be redone from scratch, ~~. Thus the data~~ and backup processing takes a long time.

Recently, the amount of data ~~in the~~ input to data processing systems ~~have been increasing rapidly~~has burgeoned, increasing the amount of data which need to be backed up. ~~On the other hand~~In contrast, ~~to minimize the effects of data-backup processing on on-line business affairs,~~the time ~~allowed~~allocated for data-backup processing has been ~~shortening~~decreasing in order to minimize the effects of data-backup processing on on-line business affairs. If data-backup processing of a system ~~comes to an~~

~~abnormal end~~ends irregularly, ~~the~~ data-backup processing has to be redone from scratch. ~~;~~ tThus data-backup processing takes ~~a long time not to be finished in the allowed~~much longer to be completed than the time allocated for ~~backup~~such processing, and may affect~~ing the~~ on-line business affairs.

~~In the case of~~With the storage-device system of JP-A-242437/2000, the effects of ~~data~~ irregular termination of backup processing ~~coming to an abnormal end~~ on ~~the~~ on-line business affairs can be lessened. However, if data-backup processing ~~comes to an abnormal end~~terminates irregularly, ~~it~~ the back-up has to be redone from scratch; accordingly ~~it~~ the data backup takes a long time to complete ~~the data backup processing~~, and the processing ~~occupying~~ties up resources such as magnetic-tape drives and data-transfer routes for a long time.

~~BRIEF~~ SUMMARY OF THE INVENTION

In accordance with the above, ~~the~~an object of the present invention is to provide a technology capable of preventing ~~the~~ backup processing from being prolonged when trouble occurs during backup ~~processing~~.

According to the present invention, resources and routes necessary for backup processing are dynamically secured to form a plurality of backup subsystems in a backup processing system for backing up ~~the~~ data ~~of~~from a data-processing computer system. ~~and b~~Backup processing ~~are~~is executed by the subsystems.

In the backup processing system of the present invention, the states of a plurality of resources such as backup servers, library devices, etc., ~~necessary~~required for data-backup processing are managed~~;~~; resources in a usable state are selected from the managed resources~~;~~; and switches in a usable state are selected from a plurality of switches ~~necessary for~~needed to form~~ing~~ routes among the selected resources.

~~Then it is~~ The system check~~ed~~s whether the resources and routes ~~for~~ forming a plurality of backup processing subsystems are secured ~~or not~~. If the resources and routes ~~for forming a plurality of backup processing subsystems~~ are secured, backup processing is executed ~~by~~ using the secured resources and routes.

~~The backup processing described above is executed by using a plurality of resources and routes so secured.~~ When ~~the~~ backup processing has been successfully executed by at least one subsystem, the backup ~~processing~~ is ~~regarded~~considered ~~as~~ successful. Alternatively, data may be backed up by at least one subsystem, and if trouble occurs during ~~the~~ backup processing, ~~it~~ the backup is continued ~~by~~ using other resources and routes.

As described above, in the backup processing system ~~according to~~ of the present invention, resources and routes ~~necessary~~needed for backing up data to be used by a data-processing computer system are dynamically secured to form a plurality of backup subsystems, and backup processing is executed; therefore, ~~the~~ backup processing is prevented from being prolonged when trouble occurs during backup ~~processing~~.

Other and further objects, features and advantages of the invention will appear more fully from the following description read in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred form of the present invention is illustrated in the accompanying drawings in which:

Fig. 1 is a schematic block diagram of an embodiment of the backup processing system of the present invention;

Fig. 2 ~~shows~~is an example of the backup processing information 410 held by the backup manager 400;

Fig. 3 ~~shows~~is an example of backup server information 420;

Fig. 4 ~~shows~~is an example of library device information 430;

Fig. 5 ~~shows~~is an example of tape information 440 held by the backup manager 400;

Fig. 6 ~~shows~~is an example of FC switch information 450;

Figs. 7 and 8 show ~~is~~ a flowchart of backup processing steps performed by backup manager 400;

~~Fig. 8 shows the rest of the back up processing by the backup manager 400;~~

Fig. 9 ~~shows~~is an example of backup data save information 460;

Fig. 10 is a flowchart of restore processing by backup manager 400;

Figs. 11 and 12 show ~~is~~ a flowchart of backup processing steps performed by backup manager 400; and

~~Fig. 12 shows the rest of the backup processing by the backup manager 400; and~~

Fig. 13 is an example of the copy device information 470 held by the backup manager 400.

DETAILED DESCRIPTION OF THE INVENTION

~~Referring to the drawings, a~~A preferred embodiment of the backup processing system of the present invention ~~will~~is ~~be~~ described below with reference to the drawings.

~~Referring to Fig. 1~~As shown in Fig. 1, ~~the~~a backup processing system is provided with a backup manager 400, which has a resource selection processor 401, a route selection processor 402, a backup processor 403, and a restore processor 404.

~~The r~~Resource selection processor 401 selects resources in a usable state from a plurality of resources such as backup servers 300, library devices 500, tapes 510, etc., ~~necessary~~required for ~~the~~ backup of data to be used in data processing by a host computer 100.

~~The r~~Route selection processor 402 selects FC (Fibre Channel) switches ~~600~~ in a usable state from a plurality of FC switches 600 ~~for~~to form~~ing~~ routes among the selected resources. When the resources and routes ~~necessary for~~required to back~~ing~~ up data ~~to be used in data processing~~ for use by ~~the~~ host computer 100 are secured to form a plurality of backup subsystems, ~~the~~ backup processor 403 ~~executes backup processes~~performs a backup operation, using the selected resources and routes.

~~The r~~Restore processor 404 finds the storage areas of backup data by using information relating backup data to their storage areas and restores data into a storage device 200 of ~~the~~ host computer 100.

A program ~~to have the~~ which controls the backup manager 400 to function as the resource selection processor 401, the route selection processor 402, the backup processor 403, and the restore processor 404 is recorded in a storage medium such as a CD-ROM, stored in a magnetic disk or the like, and then loaded in ~~a~~ memory and executed. The program may be recorded in storage media other than ~~the~~ CD-ROM. The program may be ~~installed~~ loaded from the storage medium of the program into a data processing device ~~to use the program~~, or the storage medium of the program may be accessed through a network to use the program.

The backup processing system comprises ~~the~~ host computer 100, ~~the~~ storage device 200, ~~the~~ backup servers 300, ~~the~~ backup manager 400, ~~the~~ library devices 500, fibre-channel switching devices, or FC switches, 600, and copy devices 610 ~~which take~~ that make copies of data in the host computer 100 in accordance with backup instructions.

~~The h~~Host computer 100, ~~the~~ backup servers 300, ~~the~~ backup manager 400, and ~~the~~ FC switches 600 are connected by a network 800. ~~The h~~Host computer 100, ~~the~~ storage device 200, ~~the~~ backup servers 300, ~~the~~ backup manager 400, ~~the~~ library devices 500, and ~~the~~ copy devices 610 consist of the FC switches 600 and are connected by a SAN (Storage Area Network) 700 for data transfer.

~~The h~~Host computer 100 has a backup agent 110 ~~which~~that controls the application software and database-management software of ~~the~~ host computer 100 for backup processing. ~~The s~~Storage device 200 ~~has a function to~~ records and reproduces data to be used ~~by the host computer 100~~ in accordance with requirements ~~by the~~ of host computer 100. A single magnetic ~~-dise~~ disk drive, a magnetic disk drive ~~cum~~ with a controller of a RAID (Redundant Array of Inexpensive Disks) type, or the like, may be used as ~~the~~ storage device 200.

Each library device 500 has a plurality of tapes 510 and reads data from and writes data into a tape 510, which is selected by external control, in accordance with the read and write ~~demands by~~commands from a device connected to ~~said~~ the library device 500. In the data- backup processing ~~to be~~ described later, ~~the~~ library devices 500

store copies (backup data) of the data ~~which~~that are stored in ~~the~~ storage device 200 and used by ~~the~~ host computer 100.

~~The h~~Host computer 100, ~~the~~ backup servers 300, and ~~the~~ backup manager 400 have components such as memories and CPUs that are necessary for computers, but ~~for them to have~~their having such components is not important for the present embodiment; therefore the details of such components ~~will~~ are not be described here.

In the data-backup processing ~~to be~~ described below, ~~the~~ backup manager 400 ~~accomplishes the backup of~~ backs up the data stored in ~~the~~ storage device 200 within a given time, in accordance with a schedule, by securing multiple resources ~~necessary~~ needed for backup processing and then instructing the backup servers 300 so secured to execute the backup.

~~Referring to Fig. 2, a~~An example of backup processing information 410 held by the backup manager 400 ~~will be~~is now described with reference to Fig. 2. "Process Number" means numbers allotted to backup processes. "Time" means the time and ~~the~~ date when each backup process is to start~~ed~~. ~~Held in the~~ The "Object" column ~~is~~lists information ~~to identify~~that identifies the data in ~~the~~ storage device 200 to be backed up. The information may ~~be information~~ identify~~ing~~ logical or physical volumes, file names (identifiers), database table names (identifiers), or the like.

~~The b~~Backup manager 400 ~~holds~~contains various ~~pieces~~items of information shown in Figs. 3 to 6 to manage the various resources mentioned above.

~~Referring to Fig. 3, a~~An example of backup server information 420 ~~will be~~is described with reference to Fig. 3. ~~The numbers in t~~The "Server Number" column ~~of "Server Number"~~ contains numbers that identify the backup servers 300. ~~Held in t~~The "Server Name" column ~~of "Server Name"~~ contains ~~are~~ the names (identifiers) of the backup servers 300. ~~Held in t~~The "State" column ~~of "State"~~ shows ~~is~~ the state of each backup server 300; i.e., usable, in use, or ~~unusable~~not usable. When a backup server 300 is executing a backup process in accordance with a data set in ~~the~~ backup processing information 410, the process number ~~in~~ of the data set is ~~held~~shown in the "Process Number" column. ~~of "Process Number."~~ The nNumbers in the ~~column of~~ "Stream

Number" column distinguish the multiple copies, to be made as described later, of data in a backup process.

~~Referring to Fig. 4, a~~An example of library device information 430 ~~will be~~is now described with reference to Fig. 4. The numbers in the "Library Device Number" column ~~of "Library Device Number"~~ identify ~~the~~ library devices 500. The codes (identifiers) in the ~~column of~~ "Library Device Name" column identify ~~the~~ library devices 500. The ~~columns of~~ "State," "Process Number," and "Stream Number" ~~hold the relation between~~ columns contain information relating the library devices ~~500~~ and backup processes, as in the case of the backup server information 420.

~~Referring to Fig. 5, an example of tape information 440 held by the backup manager 400 about tapes 510 in each library device 500 will be~~ Backup manager 400 contains tape information 440 about tapes 510 in each library device 500. An example of that information is now described with reference to Fig. 5. ~~The backup manager 400 has the tape information 440 on each library.~~ The numbers in the ~~column of~~ "Tape Number" column of ~~the~~ tape information 440 ~~of each library device 500~~ identify the tapes 510 of ~~said~~a library device 500. The ~~columns of~~ "State," "Process Number," and "Stream Number" ~~hold the relation between~~columns contain information relating the tapes ~~510~~ and backup processes, as in the case of ~~the~~ backup server information 420.

~~Referring to Fig. 6, a~~An example of FC switch information 450 ~~will be~~is described with reference to Fig. 6. The numbers in the ~~column of~~ "FC Switch Number" column identify ~~the~~ FC switches 600. The codes (identifiers) in the ~~column of~~ "FC Switch Name" column further identify ~~the~~ FC switches 600. The ~~columns of~~ "State," "Process Number," and "Stream Number" ~~hold~~columns contain ~~the relation between~~ information relating the FC switches 600 and backup processes as in the case of the backup server information 420.

~~Referring to Figs. 7 and 8, b~~Backup processing by ~~the~~ backup manager 400 ~~will be~~is now described with reference to Figs. 1, 7 and 8.

~~The b~~Backup manager 400 commences ~~a~~ backup ~~process~~ of the data specified by a backup data set in ~~the~~ backup processing information 410 at the time and on the date given ~~by~~in the ~~backup~~ data set (Step 1000). ~~The b~~Backup manager 400

instructs ~~the~~ backup agent 110 of the host computer ~~100~~ to prepare the backup (Step 1010).

~~The r~~Resource selection processor 401 of the backup manager 400 selects a backup server 300 from the usable backup servers ~~300~~ by using ~~the~~ backup server information 420. Resource selection processor 401 then~~,~~ changes the state information of the selected backup server 300 from "usable" to "in use", sets the process number of the selected backup server ~~300~~ to the ~~same number as the~~ process number in the backup data set ~~in the~~ of backup processing information 410, and sets the stream number of the selected backup server~~s 300~~ to "0" (Step 1020). The s~~S~~elected backup server 300 ~~will~~is hereinafter ~~be~~ called backup server "0".

In a~~the~~ similar ~~way~~manner, the resource selection processor 401 of the backup manager 400 uses library device information 430 and tape information 440, to selects a library device 500 usable for the backup process and a tape 510 in the library device. ~~500 usable for the backup process by using the library device information 430 and the tape information 440,~~ Resource selection processor 401 then changes the state information of the selected library device 500 and tape 510 from "usable" to "in use," sets the process numbers of the selected library device 500 and tape 510 to the ~~same number as the~~ process number in the backup data set ~~in the~~of backup processing information 410, and sets the stream numbers of the selected library device 500 and tape 510 to "0" (Step 1030). The selected library device 500 and tape 510 ~~will~~are hereinafter ~~be~~ called library device "0" and tape "0", respectively.

~~The~~ Using FC switch information 450, route selection processor 402 of ~~the~~ backup manager 400 selects an FC switch 600 to form ~~the~~ routes among ~~the~~ storage device 200, ~~the~~ backup server "0", and ~~the~~ library device "0". ~~by using the FC switch information 450,~~ Then, route selection processor 402 changes the state information of the selected FC switch 600 from "usable" to "in use", sets the process number of the selected FC switch 600 to the ~~same number as the~~ process number in the backup data set ~~in the~~ of backup processing information 410, and sets the stream number of the selected FC switch 600 to "0" (Step 1040).

Then ~~the~~ resource selection processor 401 and route selection processor 402 of ~~the~~ backup manager 400 select~~s~~ another backup server~~s~~ 300, another library device 500, another tape 510, and another FC switch 600 in the same way as described above, but all are given ~~a~~ stream number "1", to secure another backup route~~,~~ or subsystem (Steps 1050 to 1070). The backup server 300, ~~the~~ library device 500, and ~~the~~ tape 510 so selected ~~will~~are hereinafter ~~be~~ called backup server "1", library device "1", and tape "1", respectively.

If ~~the~~ resource selection processor 401 and ~~the~~ route selection processor 402 fail to secure two backup routes, or subsystems, as described above, the backup processor 403 of ~~the~~ backup manager 400 regards the backup process as a failure, releases the secured resources, and records the failure in a log (Steps 1180 and 1190). ~~Besides, the~~ In addition, backup processor 403 may notify the user of the failure.

If two backup routes, or subsystems, are secured, ~~the~~ backup processor 403 of ~~the~~ backup manager 400 controls ~~the~~ library device "0" to prepare ~~the~~for recording ~~of~~ the data ~~into~~onto the tape "0" (Step 1090).

Then ~~the~~ backup processor 403 of ~~the~~ backup manager 400 notifies ~~the~~ backup server "0" of the data to be backed up, the library device "0", and the tape "0", and instructs ~~the~~ backup server "0" to back up the data ~~into the~~ onto tape "0" (Step 1100).

~~The b~~Backup server "0" reads out the data to be backed up from ~~the~~ storage device 200, transfers the data to ~~the~~ library device "0", and writes the data ~~i~~onto ~~the~~ tape "0". When the backup process has ~~been finished~~ successfully completed, ~~the~~ backup server "0" notifies ~~the~~ backup processor 403 of the successful completion of the backup process. If the backup process ~~comes to an abnormal end~~ends in an irregular way, ~~the~~ backup server "0" notifies ~~the~~ backup processor 403 of the ~~abnormal end~~irregular termination (Step 1110).

While the above backup process is being executed, the backup processor 403 ~~of the backup manager 400~~ prepares ~~the~~ library device "1" and instructs ~~the~~ backup server "1" to back up the data ~~i~~onto ~~the~~ tape "1". As in the case of the backup process described above, ~~the~~ backup server "1" executes the backup process and notifies ~~the~~ backup processor 403 of the result of the backup process (Steps 1120 to 1140).

~~The b~~Backup processor 403 ~~of the backup manager 400~~ receives the information on the results of the backup processes from the backup servers "0" and "1" and checks the contents of the information to ~~judge~~determine whether the backup processes ~~to be~~were successes or failures (Step 1150). If both the backup processes ~~are failure~~fail, the backup of the data is regarded as failure (Steps 1180 and 1190). If either of the backup processes is successful, the backup of the data is regarded as a success and ~~the~~ backup processor 403 ~~of the backup manager 400~~ finds ~~the~~a storage area ~~of~~for the backed-up data ~~so backed up, or backup data,~~ and updates the backup data save information 460 (Step 1160).

~~Referring to Fig. 9, a~~An example of ~~the~~ backup data save information 460 ~~will be~~is described with reference to Fig. 9. A ~~f~~Field in the "Object" column identifies ~~backuped~~ backed-up data and includes information to distinguish logical or physical volumes, file names (identifiers), database table names (identifiers), etc. "Start Time" means the time and ~~the~~ date when a data backup process ~~of data~~ was started. "End Time" means the time and the date when the data backup process ~~of the data was~~ ended. "Data Time" means the time and the date of the data as backup data. "Library Device Number" and "Tape Number" ~~mean~~are the numbers of a library device 500 and a tape 510 in which the backup data were stored, corresponding to "Library Device Number" in ~~the~~ library device information 430 and "Tape Number" in ~~the~~ tape information 440, respectively. ~~Held in t~~The "Data Position" column ~~is~~contains information on the storage area of the backup data on ~~the~~ tape 510; for example, block addresses or the number of bytes of an offset from the head. "Data Size" is the size of the backup data in, for example, ~~the~~ numbers of blocks or bytes.

If one of the ~~above~~ two backup processes described above is successful, ~~the~~ backup processor 403 ~~of the backup manager 400~~ records, in~~to the~~ backup data save information 460, the numbers of the library device ~~500~~ and the tape ~~510 in~~on which the data have successfully been stored. If two or more backup processes are successful, the numbers of ~~the~~ library device 500 and ~~the~~ tape 510 of ~~either~~ any of the backup processes, or the numbers of ~~the~~ library devices 500 and ~~the~~ tapes 510 of two or more backup processes, are recorded in the backup data save information 460. The storage areas of the

backup data on ~~both~~ some or all of the tapes 510 or the storage area of the backup data on either tape 510 is also recorded in the backup data save information 460. ~~F~~Thus, for example, backup results of only the first successful process ~~only~~ can be selected.

~~The b~~Backup processor 403 of ~~the~~ backup manager 400 stores all or part of the backup data save information 460~~the information~~ onto each tape 510 ~~in the backup data save information 460 into said tape 510~~ (Step 1170) and thus can collect the information from ~~said~~each tape 510 as the need arises.

~~The b~~Backup processor 403 ~~of the backup manager 400~~ changes the states of ~~the~~ backup server information 420, ~~the~~ library device information 430, ~~the~~ tape information 440, and ~~the~~ FC switch information 450 ~~all~~ used for the backup processes from "in use" to "usable", ~~namely,~~ releasing ~~releases~~ the resources secured for the backup processes, and completes ~~them~~ those processes (Step 1190).

~~Referring to Fig. 10, the procedure of the~~ The restore process ~~by the~~ performed by backup manager 400 ~~will be~~is now described with reference to Fig. 10. If data stored in ~~the~~ storage device 200 are lost due to operational trouble or trouble with some device~~trouble with some device or operational trouble~~, the user checks with ~~the~~ restore processor 404 of ~~the~~ backup manager 400 about ~~the~~ the save condition~~situation~~ of backup data (Step 2000).

~~The r~~Restore processor 404 ~~of the backup manager 400 presents~~ provides information on the backup data to the user by using the backup data save information 460 (Step 2010).

The user chooses the data to be restored, ~~appoints~~assigns a storage area ~~for restoring~~ in ~~the~~ storage device 200 for the data restoration, and instructs ~~the~~ restore processor 404 ~~of the backup manager 400~~ to restore the data (Step 2020).

Using the backup data save information 460, ~~the~~ restore processor 404 ~~of the backup manager 400~~ specifies the library device 500 and the tape 510 storing data to be restored and ~~its~~specifies the data storage area on the tape. ~~;~~Restore processor 404 then refers to ~~the~~ library device information 430 and ~~the~~ tape information 440, makes sure that the states of the indicated library device 500 and the indicated tape 510 are "usable" and

changes the states of the indicated library device ~~500~~ and the indicated tape ~~510~~ to "in use" (Step 2030).

~~Also~~In addition, using ~~the~~ backup server information 420, ~~the~~ restore processor 404 ~~of the backup manager 400~~ selects a backup server 300 to be used for ~~restoring~~ the restoration from the "usable" backup servers ~~300~~, and changes the state of ~~the~~ backup server information 420 ~~of~~for the selected backup server ~~300~~ from "usable" to "in use" (Step 2040). Further, ~~the~~ restore processor 404 selects an FC switch 600 to form ~~the~~ routes among the indicated library device ~~500~~, the selected backup server ~~300~~ and ~~the~~ storage device 200, and then changes the state information of the selected FC switch 600 to "in use" in ~~the~~ FC switch information 450 (Step 2050).

Then ~~the~~ restore processor 404 ~~of the backup manager 400 controls the~~ prepares library device 500~~, and prepares~~ so that the data to be restored can be obtained from ~~the~~ tape 510 (Step 2060).

~~Then the r~~Restore processor 404 ~~of the backup manager 400~~ then notifies the selected backup server 300 of the indicated library device, ~~500, the~~the indicated tape ~~510,~~and the data to be restored, ~~its~~specifies the data storage area on the tape ~~and area~~and the area to which ~~it~~the data will be ~~is~~ restored, and instructs the backup server 300 to ~~restore~~ perform the data ~~to be restored~~restoration (Step 2070).

Upon receiving the instruction, ~~the~~ backup server 300 reads out the data to be restored from ~~the~~ tape 510 of ~~the~~ library device 500, and restores the data ~~on~~in the ~~appointed~~assigned storage area of ~~the~~ storage device 200 (Step 2080).

When the ~~instructed~~requested restore process has ~~been finished~~ successfully completed, ~~the~~ backup server 300 notifies ~~the~~ restore processor 404 of the successful completion ~~of the restore process~~. If the restore process ~~comes to an abnormal end~~ends in an irregular way, ~~the~~ backup server 300 notifies ~~the~~ restore processor 404 of the ~~abnormal end~~irregular termination (Step 2090).

~~The r~~Restore processor 404 ~~of the backup manager 400~~ records the results in a log and notifies the user of ~~the success when the notice is~~ a successful completion, ~~and the failure when the notice is an abnormal end, respectively~~ or of a failure if the restoration process ends irregularly (Step 2100).

~~The r~~Restore processor 404 ~~of the backup manager 400~~ changes the state of various information for the restore process from "in use" to "usable", ~~namely,~~ releasinges the resources so secured, and completes the restore process (Step 2110).

As described above, in the backup processing system according to the present embodiment, resources and routes ~~neeessary~~needed for backing up data to be used by ~~a~~ host computer 100 are dynamically secured as required to form a plurality of backup subsystems, and backup processing ~~are~~is executed in parallel by the plurality of backup subsystems. Therefore, even when trouble occurs during any of the ~~plurality of~~ multiple backup ~~processing~~operations, ~~such~~ the backup processing is ~~prevented from being~~not prolonged and ~~the backup processing~~ can be completed within a given time.

In the backup processing described above, the backup is executed in parallel by a plurality of backup servers 300. In the backup processing ~~referring~~ described below with reference to Figs. 11 and 12 ~~below~~, however, ~~the~~a copy device 610 (see Fig. 1), ~~making~~which makes copies of data for the backup is switched when trouble occurs.

~~Fig. 11 is a flowchart of the first 10 steps of back up processing by backup manager 400 of the present embodiment.~~

Figs. 11 and 12 ~~is~~ show a flowchart ~~showing the rest~~ of ~~the~~ backup processing by ~~the~~ backup manager 400 ~~of the present embodiment~~in accordance with another embodiment of the present invention. As in the processing described above, ~~a~~ resource selection processor 401 of ~~the~~ backup manager 400 start~~sing~~ backup processing. ~~, by using~~ Using copy device information 470, the resource selection processor selects a copy device 610 to be used for ~~the~~ backup processing from the usable copy devices ~~610~~ and sets copy device information 470 (Step 3000).

The selected copy device 610 ~~will~~is hereafter ~~be~~ called copy device "0". The selection of ~~the~~ copy device "0" and the setting ~~to the~~of the copy device information 470 ~~made~~ by ~~the~~ backup manager 400 are the same ~~as what are~~ as was done ~~to~~with ~~the~~ backup server 300 and ~~the~~ backup server information 420 in ~~the~~ previously described backup processing.

Fig. 13 is an example of ~~the~~ copy device information 470 ~~held by the~~ contained in backup manager 400 of the present embodiment. The numbers in the ~~column of~~ "Copy Device Number" column identify the copy devices 610. ~~Held in the column of~~ The "Copy Device Name" ~~are~~column lists the names (identifiers) of the copy devices 610. The state, process numbers and stream numbers are the same as those ~~of the~~in backup server information 420.

Further, as in the backup process described above, ~~the~~ backup manager 400 selects ~~the~~ library device "0", ~~the~~ tape "0", ~~the~~ copy device "1", ~~the~~ library device "1", ~~the~~ tape "1" and ~~the~~an FC switch 600, and secures the selected equipment (resources) by setting the various information (Step 3010). If ~~the~~ backup manager 400 fails to secure two or more backup routes~~,~~ or subsystems, ~~as~~then, as in the ~~above~~previously described backup process, the backup manager ~~400~~ regards the backup process as a failure (Step 3160)~~,~~ and releases the resources secured for the backup process (Step 3170).

~~Then the~~ When two or more routes or subsystems are secured, backup processor 403 of ~~the~~ backup manager 400 controls ~~the~~ library device "0" and ~~the~~ library device "1" to prepare for the recording of the data ~~into the~~ onto tape "0" and ~~the~~ tape "1" (Steps 3030, 3040).

Then ~~the~~ backup processor 403 ~~of the backup manager 400~~ instructs ~~the~~ copy device "0" to backup (copy) the target data (i.e., the data to be backed up) into the onto tape "0" of ~~the~~ library device "0" (Step 3050). ~~As~~ an example of a backup ~~directive~~ commands instructing the copy~~, there~~ is an EXTENDED COPY command specified in the SCSI (Small Computer System Interface). When ~~using~~ EXTENDED COPY commands are used, copying can be instructed by specifying a device from which data is copied, a device to which data is copied, an address of the area from which data is copied, an address of the area to which data is copied and copy length, etc., as parameters.

~~The b~~Backup processor 403 ~~of the backup manager 400 e~~executes copying of the data to be backed up by dividing ~~it~~that data into ~~a plurality of~~multiple processes with ~~a plurality of~~ multiple EXTENDED COPY commands. If the data to be copied, for example, is ~~of the size of~~ 100 Mbytes in size, ~~a~~ copy length is set as 10 Mbytes ~~each~~

~~by~~using 10 commands, and the copying process is repeated 10 times. By dividing the copy process, fine-particle size by command during a trouble-shooting procedure can be realized. Further, ~~a~~ prompt trouble-shooting is ~~given~~provided and the backup process can be continued.

~~The e~~Copy device "0" executes the instructed copy process, and informs ~~the~~ backup processor 403 of successful completion when the copy process is successfully completed and of an ~~abnormal end~~irregular termination when the copy process comes to an ~~abnormal~~irregular end (Step 3060).

Upon receiving a report of ~~the~~ successful completion, ~~the~~ backup processor 403 ~~of the backup manager 400~~ records in backup data save information 460, ~~with respect to the data whose copy process is successfully completed,~~ the library device "0", ~~the~~ tape "0", and the storage area of data on the tape, with respect to the data whose copy process has been successfully completed ~~in the backup data save information 460~~ (Step 3080). When there is data which has not yet been copied ~~yet~~, ~~the~~ backup processor 403 issues the next copy command to the copy device "0" (Step 3090). When the whole copying process of the data to be backed up has been~~is~~ completed, the backup process is regarded as successful (Step 3150) and the resources secured for the backup process ~~is~~are released (Step 3170).

When ~~receiving~~ backup processor 403 receives a report of ~~abnormal end~~an irregular termination of the copy process from ~~the~~ copy device "0", or ~~reaching~~reaches a time-out without receiving any reports from ~~the~~ copy device "0", ~~the backup processor 403 of the backup manager 400~~ the backup processor indicates~~, with respect to~~ that the data whose copy process has not successfully completed~~,~~ ~~the~~ will now be copied by copy device "1" ~~to copy t~~to ~~the~~ tape "1" of ~~the~~ library device "1" (Step 3100).

The copy device "1" executes the instructed copy process and, as described above, informs ~~copy results to the~~ backup processor 403 of the ~~backup manager 400~~ copy results (Step 3110).

When ~~receiving~~ a report of successful completion is received, ~~the~~ backup processor 403 stores in backup data save information 460, ~~with respect to the data whose copy has been successfully completed, the~~ library device "1", ~~the~~ tape "1" and the storage

area of data on the tape, with respect to the data whose copying has been successfully completed ~~into the backup data save information 460~~ (Step 3130). If there is data which has not yet been copied ~~yet~~, the backup processor issues the next copy instruction command to ~~the~~ copy device "1" (Step 3140).

When the whole copying process of the data to be backed up ~~is~~has been completed, the backup process is regarded as successful (Step 3150) and the resources secured for the backup process ~~is~~are released (Step 3170). When ~~receiving~~backup processor 403 receives a report of ~~abnormal end~~an irregular termination of the copy process from ~~the~~ copy device "1", or ~~reaching~~ reaches a time-out, the backup process is regarded as failure (Step 3160) and the resources secured for the backup process ~~is~~are released (Step 3170).

When switching of the backup processes occurs, as described above ~~occurs~~, the backup data is divided into ~~a plurality of~~multiple sections and stored in ~~the~~ two or more library devices 500 and ~~the~~ tapes 510. Such sections of the backup data and their storage area are respectively recorded in ~~the~~ backup data save information 460 and managed. Namely, the backup data save information 460 may have entries of ~~a plurality of~~multiple storage areas with respect to backup data of ~~given~~ data ~~to be~~that was selected for back~~ed~~ up.

As described ~~in the~~ above in the restore process, when ~~the~~ backup manager 400 restores data, it requests, ~~by~~ using ~~the~~ backup data save information 460, ~~the presentation~~ identification of the restorable data and the storage area of data to be restored. However, w~~W~~hen the backup data (data to be restored) is divided and stored, as described immediately above, ~~however, the~~ restore processor 404 of the backup manager 400 obtains, ~~by~~ using ~~the~~ backup data save information 460, the identification of each storage area (the tape 510 of the library device 500). ~~The r~~Restore processor 404 then sequentially secures the library device/tape, gives a restore instruction to ~~the~~ backup server 300 or to ~~the~~ copy device 610 and then releases the library device/tape, eventually restoring~~so as to restore~~ all the data ~~to be restored~~.

As previously described, in the backup processing system of the present embodiment, resources and routes ~~necessary~~ needed for backing up data to be used by a

host computer 100 are dynamically secured, according to the state of each ~~state~~ resource, to form a plurality of backup subsystems. Therefore, when trouble occurs during any of the ~~plurality of~~ multiple backup ~~processing~~processes, ~~the~~ backup processing ~~is continued~~ continues in another system and such ~~backup~~ processing, ~~is prevented from being prolonged and~~being free of delays, can be completed within a given time.

~~In the above backup processing, t~~The backup ~~is~~ process described above ~~started~~ starts ~~by the~~ with an instruction of a user, ~~and~~ according to ~~the~~ a date and time set by ~~the~~ backup process information 410. ~~Also~~Alternatively, the user may give an instruction to start the backup immediately, in an on-demand manner.

Further, ~~the~~ FC switch 600 may have a zoning function grouping ~~a plurality of~~ multiple ports ~~owned~~ managed by the FC switch 600 and allowing access and transfer within each group. Accordingly, in selecting and securing resources (routes) described above for ~~in the above~~ backup ~~processing~~ and restore processing, ~~the~~ backup manager 400 sets ~~the~~ FC switch 600 via a network 800, executes zoning the selected route as an independent route and carries out the processing so that the data transfer ~~in~~ of the backup ~~processing~~ or ~~the~~ restore processing does not influence a transfer in the processing being executed by another computer and is not influenced by such transfer.

In both of the ~~above~~ above-described backup ~~processing~~processes, two resources (routes) are secured and the processing is ~~made~~carried out. However, in order to improve the trouble-~~preventive~~ prevention function of the present invention, three or more routes may be used to carry out the processing.

In the ~~above~~ backup ~~processing~~ and restore processing described above, when data to be backed up or restored are files or database tables, ~~the~~ backup manager 400 and ~~the~~ backup server 300 have means to translate file management ~~information of file systems~~ and database management information to other file formats or database formats as needed or otherwise deemed appropriate.

Further, the backup processing method described above can be applied when creating a copy (snapshot) of data ~~by~~ on the storage device 200 and acquiring the backup with respect to the copy.

In the above description, ~~the~~ host computer 100, ~~the~~ backup server 300 and ~~the~~ backup manager 400 are ~~regarded~~ shown as different computers. However, one or more computers may have the means and functions of the above computers, and may ~~carries~~ carry out ~~the~~ backup processing in the same way as described above.

In the ~~former~~ backup processing described above, ~~the~~ backup manager 400 manages various information and carries out the backup processing ~~by~~ using ~~the~~ backup server 300. However, as an example of an alternative configuration, each backup server 300 may manage while synchronizing the information so that the contents will be the same on each backup server 300, and can achieve the backup processing by carrying out the processing previously done by the backup manager 400 in the above description.

~~Also~~Moreover, in the description of the ~~latter~~ backup process, the routes are switched ~~according to~~with the occurrence of an ~~abnormal end~~irregular termination of the EXTENDED COPY command. However, routes may be switched by using other transfer instruction methods~~.~~. ~~F~~for example, such as ~~according to abnormal ends~~with the occurrence of an irregular termination ~~of~~ a data transfer based on a block, a track or a cylinder ~~of the~~ from storage device 200, transferred as a unit.

Further, in the backup process described above ~~description~~, the storage area of the backup data is on ~~the~~ tape 510 of ~~the~~ library device 500. However, ~~it may be~~ other storage devices such as a single magnetic disk unit or a magnetic disk unit with a controller having a RAID configuration, etc., may be used.

As described above, according to the backup processing system of the present ~~embodiment~~invention, resources and routes ~~necessary~~ needed for backing up data to be used by a data-processing computer system are dynamically secured to form ~~a plurality of~~ multiple backup subsystems, and backup processing is executed by the subsystems.~~;~~ Therefore, ~~the~~ backup processing is prevented from being ~~prolonged~~ delayed when trouble occurs during backup processing.

~~According to the present invention, resources and routes necessary for backup processing are dynamically secured to form a plurality of backup subsystems in a backup processing system for backing up the data of a data-processing computer system~~

~~and backup processing are executed by the subsystems. Therefore, the backup processing is prevented from being prolonged when trouble occurs during backup processing.~~

The foregoing invention has been described in terms of the preferred embodiments. However, those skilled, in the art will recognize that many variations of such embodiments exist. Such variations are intended to be within the scope of the present invention and the appended claims.

APPENDIX C: ABSTRACT AS FILED, WITH MARKINGS TO SHOW CHANGES MADE

Please amend the Abstract as follows:

~~The present invention provides a technology capable of preventing backup processing from being prolonged when trouble occurs during the backup processing.~~

A backup processing method for backing up data to be used by a data-processing computer system comprises~~: a step of~~ selecting resources in a usable state from a plurality of resources necessary for the data to be used by the data-processing computer system, ~~a step of~~ selecting switches in a usable state from a plurality of switches ~~necessary for forming~~ needed to form routes among said selected resources, and ~~a step of~~ executing backup processing by using ~~said~~ the secured resources and routes when the resources and routes necessary for backing up data to be used ~~in~~ by the data processing ~~by the~~ computer system are secured to form ~~a plurality of~~ multiple backup subsystems ~~by said selection~~.

APPENDIX D: PENDING CLAIMS 1 - 15

1. A backup processing method for backing up data to be used by a data-processing computer system, the method comprising the steps of:

selecting resources in a usable state from a plurality of resources necessary for backing up data, the data to be used by the data-processing computer system;

selecting switches in a usable state from a plurality of switches necessary for forming routes among the selected resources;

determining which of the selected resources and selected routes are secure; and

executing backup processing by using secured resources and routes when the resources and routes necessary for backing up data to be used in data processing by the computer system are secured, to thereby form a plurality of backup subsystems by the selection.

2. A backup processing method according to claim 1, wherein backup processing is executed by using the plurality of resources and routes so secured, and when the backup processing has been successfully executed by at least one subsystem, regarding the backup processing as successful.

3. A backup processing method according to claim 1, wherein data is attempted to be backed up by at least one subsystem of the secured plurality of resources and routes, and if a problem occurs during the backup processing, continuing the backup processing using other resources and routes.

4. A backup processing method according to claim 3, wherein the backup processing includes a step of executing a backup instruction command, and wherein a problem in backup processing is detected by a result of the execution of the backup instruction command.

5. A backup processing method according to claim 4, wherein data to be backed up is processed by being copied at least two times in response to the backup instruction command.

6. A backup processing method according to claim 2, further including a step of storing information relating to the backup processing of the backed-up data.

7. A backup processing method according to claim 2, further including a step of storing information relating to whether the backup processing of the backed-up data was successfully executed.

8. A backup processing method according to claim 7, wherein data stored relating to the successful execution of the backup processing is used to determine if the data can be restored.

9. A backup processing system for backing up data to be used by a data-processing computer system, the system comprising:

a resource selection processor for selecting resources in a usable state from a plurality of resources necessary for the backup of data ;

a route selection processor for selecting switches in a usable state from a plurality of switches to form routes among the selected resources; and

a backup processor for executing backup processes using the selected resources and the selected routes necessary for backing up data, giving preference to those resources and routes which are secured.

10. A program having a computer function as a backup processing system for backing up data to be used by a data-processing computer system, the program comprising:

a resource selection processor portion for selecting resources in a usable state from a plurality of resources necessary for the backup of data to be used in data processing by the computer;

a route selection processor portion for selecting switches in a usable state from a plurality of switches for forming routes among the selected resources; and

a backup processor portion for executing backup processing by using the selected resources and routes when the resources and routes necessary for backing up data to be used in data processing by the computer are secure to thereby form a plurality of backup subsystems.

11. **(New)** A method for performing a data backup operation comprising:

identifying a data storage resource from among a plurality of data storage resources;

identifying a data communication channel resource from among a plurality of data communication channel resources; and

performing a first backup operation of data in a computer system using the data storage resource and data communication channel resource so identified.

12. **(New)** The method of claim 11 further including detecting a failure in the backup operation and in response thereto identifying another data storage resource from the plurality of data storage resources, identifying another data communication channel resource from the plurality of data communication channel resources and performing another backup operation using the other data storage resource and data communication resource so identified.

13. **(New)** The method of claim 11 further comprising:

identifying another data storage resource from the plurality of data storage resources;

identifying another data communication channel resource from the plurality of data communication channel resources; and

performing another backup operation using the other data storage resource and data communication resource so identified concurrently with the first backup operation.

14. **(New)** In a computer system, a method for backing up data comprising:

performing a first backup operation using a first set of resources to backup first data contained in the computer system;

performing a second backup operation using a second set of resources to backup the first data; and

performing the first backup operation concurrently with performing the second backup operation, thus providing redundancy in the backup operation to increase the likelihood of a successful backup operation.

15. **(New)** The method of claim 14 further including detecting an occurrence where the first backup operation and the second backup operation do not perform a successful backup operation, and in response thereto, performing at least a third backup operation using a third set of resources.